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DESCRIPTION

DATA PROCESSOR

TECHNICAL FIELD

The present invention relates to processing of transferring a data stream concerning video and/or audio between multiple devices.

BACKGROUND ART

Recently, apparatuses that can record and play compressed and encoded digital data streams, concerning contents such as video and/or audio, on/from a storage medium such as an optical disk have become more and more popular. Most of those apparatuses record those data streams on a storage medium so as to comply with a predetermined standard (i.e., a recording format) and ensure playback compatibility between apparatuses. Taking a DVD as one of various optical disks as an example, there are a number of standards for recording a data stream on a DVD. Examples of those standards include the DVD Video standard (which will be simply referred

to herein as "Video standard") and the DVD Video Recording standard (which will be simply referred to herein as "VR standard"). The Video standard defines a recording format for a package medium on which a read-only data stream such as a movie is stored. Meanwhile, the VR standard defines a recording format for recording a data stream in real time and making it editable afterward.

A recorder on the market cannot always record a data stream so as to comply with every currently effective standard. Thus, an appropriate standard is selected for the recorder according to its purpose, price range or any other criterion. The recorder normally can neither analyze nor record a data stream that does not comply with its own standard.

Suppose two optical disk drives are connected together such that a data stream is output from one of the two drives (which will be referred to herein as a "drive on the transmitting end") and the other drive (which will be referred to herein as a "drive on the receiving end") records it on a storage medium. This is what they call a "data stream

transfer (copying) process". A data stream compliant with the VR standard is supposed to be stored on an optical disk in the drive on the transmitting end. On the other hand, the drive on the receiving end is supposed to record a data stream only in compliance with the Video standard.

In that case, even if the drive on the transmitting end outputs the VR-compliant data stream as it is to the drive on the receiving end, the drive on the receiving end can neither analyze the data stream nor record it on a storage medium. That is why the drive on the transmitting end converts the VR-compliant data stream into a Video-compliant data stream and then outputs it to the drive on the receiving end. Then, the drive on the receiving end can record the received Video-compliant data stream on a DVD as it is (i.e., without processing the data stream).

However, it takes a lot of time to complete this conventional transfer process (i.e., there is a long delay from the start to the end of the transfer process). This is because the drive on the transmitting end restructures the entire data stream such that the resultant data stream will

comply with the recording format of the drive on the receiving end. As used herein, the "data stream restructuring" means a process of decoding a VR-compliant data stream and then re-encoding it such that the resultant data stream complies with the Video standard. In this case, even if it is actually unnecessary to restructure the data stream, the conventional drive on the transmitting end always restructures the entire data stream while reading it as in normal playback operation, thus taking a long time to complete the transfer process.

Also, if the drive on the transmitting end can process moving picture streams that are compliant with multiple standards, then the drive on the transmitting end needs to sense what standard the given data stream is compliant with and then determine whether or not the data stream needs to be converted. In that case, it takes an even longer time to complete the transfer process.

Thus, an object of the present invention is to identify the standard that a given data stream is compliant with and transfer the data stream at high speed between multiple

devices.

DISCLOSURE OF INVENTION

A data processor according to the present invention transfers a data stream, which is stored on a storage medium, to a connected device. The data stream includes attribute information that specifies the format of the data stream. The data processor includes: an interface section, which communicates with the device to acquire format information about a format that is compatible with the device; a reading section for reading the attribute information and the data stream from the storage medium; a reading control section for determining, based on the attribute information and the format information, whether or not the format of the data stream needs to be converted; and a converting section for outputting the data stream either after having converted the format of the data stream into the one specified by the format information or without converting the format of the data stream as determined by the reading control section. The interface section transmits the data stream, which has

been output from the converting section, to the device.

In the data stream, the attribute information, as well as copied management information, may be stored on the storage medium. The reading section may read the management information and extract the attribute information.

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The reading section may change the read rates of the data stream depending on whether or not the format needs to be converted.

The reading section may read the data stream at a first rate if the format needs to be converted, but read the data stream at a second rate, which is higher than the first rate, if the format need not be converted.

A data processing method according to the present invention is carried out by a data processor for transferring a data stream, which is stored on a storage medium, to a device that is connected to the data processor. The data stream includes attribute information that specifies the format of the data stream. The method includes the steps of:

communicating with the device to acquire format information about a format that is compatible with the device; reading the attribute information and the data stream from the storage medium; determining, based on the attribute information and the format information, whether or not the format of the data stream needs to be converted; and outputting and transmitting the data stream to the device either after having converted the format of the data stream into the one specified by the format information or without converting the format of the data stream in accordance with the result of the step of determining.

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BRIEF DESCRIPTION OF DRAWINGS

FIG. **1(a)** illustrates a camcorder **10** and a DVD recorder **20** that are connected together so as to transfer a data stream.

FIG. **1(b)** shows examples of combinations of data streams **A** and **B** with their relative lengths of transfer times according to a preferred embodiment of the present invention.

FIG. **2** shows an arrangement of functional blocks in a data processor **10** according to a preferred embodiment of the present invention.

FIG. **3** shows the data structures of a moving picture file **12** and a management file **14** that are stored on an optical disk **131**.

FIG. **4** shows a more detailed data structure of the

moving picture stream **11**.

FIG. **5(a)** shows the data structure of an auxiliary information pack **40**.

FIG. **5(b)** shows correspondence between the ID of attribute information **52** and the contents of attribute data U_PK_data **53** described according to the ID.

FIG. **6** shows the types of IDs described in the U_PK attribute information box **19** and their associated types of U_PK stored data

FIG. **7** is a flowchart showing the procedure of a transfer process to be done by the data processor **10**.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, processing according to the present invention will be described with reference to FIGS. **1(a)** and **1(b)** first, and then the configuration and operation of a data processor that carries out the processing will be described.

FIG. **1(a)** illustrates a camcorder **10** and a DVD recorder **20** that are connected together so as to transfer a data stream. In the example shown in FIG. **1(a)**, the data stream is

supposed to be transferred from the camcorder **10** to the DVD recorder **20**.

The camcorder **10** shoots video and audio and stores a moving picture file as data stream **A** on an optical disk **131** loaded inside. As the recording format, one of the DVD-VR standard and the DVD-Video standard is selected responsive to the user's operation, for example. In the data stream **A**, attribute information, specifying the format of the data stream **A**, is provided at a predetermined location to be described later.

Also, the camcorder **10** communicates with the DVD recorder **20** to acquire the format information of the DVD recorder **20**. As used herein, the "format information" is a piece of information specifying the format that can be processed by the DVD recorder **20**. The DVD recorder **20** is supposed herein to be able to record a data stream in the format defined by either the VR standard or the Video standard. When the DVD recorder **20** connected is identified, its format will be known by itself, too. In the example shown in FIG. **1(a)**, the data stream that can be recorded by the DVD recorder **20** on an

optical disk **134** is referred to as "data stream **B**".

On reading the moving picture file, representing the data stream **A** and also including the attribute information, from the optical disk **131**, the camcorder **10** compares that attribute information to the format information, thereby determining whether or not the format of the data stream **A** should be converted. That is to say, if the data stream **A** has a format that makes it recordable by the DVD recorder **20**, then the camcorder **10** decides that the format conversion need not be done. Otherwise, the camcorder **10** decides that the format conversion should be done.

If the camcorder **10** has decided that the format conversion need not be done, then the camcorder **10** outputs the data stream **A** as the data stream **B** without processing the data stream **A**. In response, the DVD recorder **20** receives the data stream **B** and records it as it is on the optical disk **134**.

On the other hand, if the camcorder **10** has decided that the format conversion should be done, then the camcorder **10** converts the format of the data stream **A** into one specified by the format information and then outputs the resultant stream

as the data stream **B**. In response, the DVD recorder **20** receives the data stream **B** and records it as it is on the optical disk **134**.

FIG. **1(b)** shows examples of combinations of data streams **A** and **B** with their relative lengths of transfer times according to this preferred embodiment. The combination **(a)** shows an exemplary situation where both of the data streams **A** and **B** comply with the VR standard, while the combination **(d)** shows an exemplary situation where both of the data streams **A** and **B** comply with the Video standard. In these two situations, the data stream can be transferred in a relatively short time. The reason is that since no format conversion is necessary, the data stream **A** can be read and output from the optical disk **131** at a read rate that is several to several tens of times as high as a normal read rate.

On the other hand, the combinations **(b)** and **(c)** show situations where the data streams **A** and **B** have mutually different formats. In these two situations, the transfer time of the data stream becomes as long as the conventional one (which is shown as "normal" in FIG. **1(b)**) because it takes a

lot of time to get the conversion done and the data stream **A** cannot be read out quickly from the optical disk **131** due to the conversion.

Next, the configuration of the camcorder **10** will be described. In the following description, however, the camcorder **10** will be referred to herein as a "data processor **10**" to describe its configuration more generally. That is to say, the camcorder described above is one typical embodiment of the data processor **10**. However, a device having the following functions falls within the range of the data processor of the present invention even if that device is not a camcorder.

FIG. **2** shows an arrangement of functional blocks for a data processor **10** according to this preferred embodiment. The data processor **10** writes a data stream on an optical disk **131** as an exemplary storage medium. The optical disk **131** may be a DVD-RAM disk, for example. The optical disk is not an essential component for the data processor **10** but is shown in FIG. **1** for convenience sake. The data processor **10** is actually made up of the other components shown in FIG. **1**. An

example in which the storage medium is an optical disk **131** will be described herein. However, the same statement equally applies to even a situation where a semiconductor storage medium such as a memory card is used, for example.

The data processor **10** has the three functions of recording, playing back and transferring a data stream. More specifically, the recording function is a function of the data processor **10** that receives a digital or analog signal concerning video and/or audio and writes a data stream, obtained from the signal, on the optical disk **131**. The playback function is another function of the data processor **10** that reads the data stream stored on the optical disk **131** to play back the video and/or audio. And the transfer function is another function of the data processor **10** that transfers the data stream, stored on the optical disk **131**, to an external device. In transferring the data stream, the data processor **10** determines whether or not the format of the stream should be converted. If the format conversion is necessary, then the data processor **10** reads the data stream at a standard rate, converts the data stream into a format that

can be processed by the external device connected, and then outputs the resultant stream. On the other hand, if the format conversion is unnecessary, then the data processor **10** reads the data stream from the optical disk **131** at a high rate and outputs it as it is to the external device.

The main function of the data processor **10** of this preferred embodiment is the function of transferring a data stream. Hereinafter, the data structure of the data stream stored on the optical disk **131** will be described with recording and playback functions mentioned and then the transfer function will be described. It should be noted that the data processor **10** is supposed to have these three functions just for the sake of convenience of description. Rather the data processor **10** has only to have the transfer function to be described in detail later, and may or may not have the recording and playback functions.

First, those components of the data processor **10** for realizing the recording function thereof will be described. The data processor **10** includes a video signal receiving section **100**, an encoded data generating section **101**, an audio

signal receiving section **102**, an input digital interface section **103**, a management file generating section **106**, a writing control section **115**, a continuous data area detecting section **116**, a logic block management section **117**, a writing section **119** and an optical pickup **130**.

The video signal receiving section **100** receives a video signal. The video signal may be a non-compressed and non-encoded digital signal representing a still picture or moving pictures, which has been supplied from the imager (CCD) of a digital still camera, or an analog signal of a televised wave, for example. The audio signal receiving section **102** receives an audio signal concerning audio. The audio signal may be a signal output from a microphone while moving pictures are being shot, for example. The video signal receiving section **100** and audio signal receiving section **102** are described herein so as to receive the video signal and the audio signal independently of each other. However, the present invention is also applicable effectively to even a situation where the video signal and audio signal are compressed, encoded and multiplexed digital broadcast signals.

In receiving a digital broadcast signal, a single receiving section may be provided and the processing to be done by the encoded data generating section **101** described below may be omitted. The following preferred embodiments will be described on the supposition that the video signal receiving section **100** and audio signal receiving section **102** receive signals representing moving pictures and their accompanying audio, respectively. Both the video signal and audio signal will be regarded as signals in an analog format that have not been digitally compressed and encoded.

The encoded data generating section **101** encodes the video signal and audio signal in predetermined encoding formats (e.g., in the MPEG2-Video and AC-3 formats, respectively). Alternatively, the encoded data generating section **101** may generate data complying with the format to be adopted during writing. For example, the encoded data generating section **101** may divide the encoded video and audio data into data units complying with the respective recording formats and add a header and so on thereto, thereby making video packs and audio packs. Also, the encoded data generating section **101**

generates RDI packs in performing a VR-compliant recording operation and generates navigation packs in performing a Video-compliant recording operation, respectively. Furthermore, the encoded data generating section **101** generates auxiliary information packs U_PK in the MP4 file format as will be described later.

The input digital interface section **103** (which will be referred to herein as an "input D-IF section **103**") is connected to an external device and receives a digital signal from the device, thereby acquiring a file of digital data. The "external device" may be the DVD recorder **20** or a PC (personal computer), for example. The input D-IF section **103** acquires a still picture data file for a still picture, an MPEG data file for moving pictures, and an AC3 data file for audio, respectively. The input D-IF section **103** is a digital interface such as an IEEE 1394 interface or a USB (universal serial bus) interface.

The management file generating section **106** generates a management file compliant with the MP4 file format in accordance with the result of encoding processing that has

been performed by the encoded data generating section **101**. FIG. **3** illustrates an exemplary management file **14** as will be referred to later. In the management file, attribute information, specifying the format of the data stream stored in a moving picture file, is described.

The writing section **119** gets the file written by the pickup **130** on the optical disk **131**. This write operation is controlled by the writing control section **115**. In accordance with the instruction given by the writing control section **115**, the continuous data area detecting section **116** checks the availability of sectors, which are managed by the logic block management section **117**, thereby detecting a physically continuous empty area available. As a result, the management file is written on a management information area **132**, to which a predetermined amount of data is assigned from the inner edge of the optical disk **131**, while the moving picture file is written on an AV data area **133**, which is provided outside of the management information area **132**. By arranging the management file exclusively on the inside portion of the disk, faster access and quicker readout are realized.

Hereinafter, the data structures of files written on the optical disk **131** will be described with reference to FIGS. **3** through **6**. FIG. **3** shows the data structures of a moving picture file **12** and a management file **14** that are stored on the optical disk **131**. The moving picture file **12** and management file **14** shown in FIG. **3** were recorded so as to comply with the MP4 file format. The MP4 file format is defined by the MPEG-4 system standard (ISO/IEC 14496-1), can deal with stream data, and is highly compatible with a PC. In the MP4 file format, moving picture streams compliant with VR, Video and various other standards can be recorded.

The MP4 file format is defined based on the QuickTime™ file format of Apple Corporation, and is a promising format because it is currently supported by various PC applications. The QuickTime file format, which forms the basis of the MP4 file format, is now used extensively as a file format for handling moving pictures and audio in the fields of PC applications.

On the optical disk **131**, a moving picture file **12**, including a moving picture stream (P2 Stream) **11**, and a

management file **14**, including management information **13**, are stored. The moving picture file **12** is written on an AV data area **133** of the optical disk **131**, while the management file **14** is written on the management information area **132** of the optical disk **131**. The moving picture file **12** will also be referred to herein as a "Movie Take File".

The moving picture stream **11** may be a system stream as defined by the MPEG-2 system standard (ISO/IEC 13818-1), for example. Three types of system streams, namely, a program stream (PS), a transport stream (TS) and a PES stream, are defined. However, the MPEG-2 system standard defines no data structure to store the management information (including access information, special playback information and recording date/time information) for these system streams. In the following description, the moving picture stream **11** is supposed to have been compressed and encoded as an MPEG program stream.

The moving picture stream **11** includes a plurality of samples (P2Samples) **15**. Each of these samples **15** is composed as a mixture of video data and audio data and may be defined

by the video playback duration, the amount of data (or data size) or any other parameter. For example, each sample **15** may include video data in an amount corresponding to a video playback duration of about 0.4 to 1 second as in a video object unit (VOBU) in a DVD. A set of one or more samples **15** will be referred to herein as a "track (P2Track) **16**".

FIG. **4** shows a more detailed data structure of the moving picture stream **11**. Each sample **15** includes one auxiliary information pack U_PK **40** at its top, which is followed by a plurality of video packs such as a video pack V_PK **41** and a plurality of audio packs A_PK such as an audio pack A_PK **42**. It should be noted that the auxiliary information pack **40** may not be included in every sample.

Each pack includes a pack header and PES packets in which the auxiliary information and video and audio data are stored. Each and every pack has a constant data size of 2,048 bytes. The following description will be focused on the structure of the auxiliary information pack and the contents of information stored in the pack.

FIG. **5(a)** shows the data structure of the auxiliary

information pack **40**. The auxiliary information pack **40** includes a pack header **51** at its top, attribute information U_PK_ID **52** showing the attribute of the moving picture stream **11**, and attribute data U_PK_data **53**. In the pack header **51**, information that identifies this as the pack header **51** among various packs is described. The attribute information U_PK_ID **52** describes information that shows which of the two recording standards the data stored in the sample **15** complies with. As shown in FIG. **5(a)**, the attribute information **52** is stored at the 45th byte and on as counted from the top of the auxiliary information pack **40**. Thus, the converting section **121** of the data processor **10** (to be described later) can find its storage location and can retrieve the information. On the other hand, the attribute data U_PK_data **53** describes information about the recording standard specified by the attribute information U_PK_ID **52**, e.g., information about the aspect of the encoded video stream.

FIG. **5(b)** shows correspondence between the ID of the attribute information **52** and the contents of the attribute data U_PK_data **53** described according to the ID. The

attribute information 52 may have IDs represented as hexadecimal numbers such as "00", "60" and "FF". And data associated with that ID is described as the attribute data 53. For example, if the sample 15 includes a VR-compliant moving picture stream, then the ID "60" is added and auxiliary information a about the VR-compliant stream is described as the attribute data U_PK_data 53. On the other hand, if the sample 15 includes a Video-compliant moving picture stream, then the ID "00" is added and auxiliary information b about the Video-compliant stream is described as the attribute data U_PK_data 53. Thus, it can be seen by the value of the attribute information 52 which recording standard the moving picture stream of the sample 15 complies with.

The management information 13 will be described with reference to FIG. 3 again. The management information 13 includes access information that designates a storage location on a sample-by-sample basis. The access information and other pieces of information are described in Sample Table Box 18 in Movie Box 17 within the management information 13. In other words, the sample is managed as the minimum management unit in

the Sample Table Box **18** and the access information representing the data storage location and so on is described for each sample. It should be noted that the "sample" **15** and "track" **16** are just units of the moving picture stream **11** to be managed with the management information **13** and the data of the moving picture stream **11** is not always defined as physically divided ones. Optionally, in the management information **13**, access information may be defined for each track **16**. The encoded data generating section **101** generates the moving picture stream (P2stream) **11** such that its data structure matches the structure described above.

In the QuickTime file format, a structure called "Atom" is adopted and is quite similar to the structure called "Box" described above. Thus, if the term "Box" is replaced with the term "Atom", then this description about the MP4 file format also applies to the QuickTime file format, too.

Meanwhile, the management information **13** includes a U_PK attribute information box (U_PK information box) **19**. In the U_PK attribute information box **19**, the same ID as that stored in the U_PK attribute information **52** (see FIG. **5(a)**) is copied

and stored. Alternatively, the same data as the U_PK data **53** shown in FIG. **5(a)** may be stored in the U_PK attribute information box **19**. FIG. **6** shows the types of IDs described in the U_PK attribute information box **19** and their associated types of U_PK stored data. This is substantially the same as the correspondence between the ID of the attribute information **52** and the contents of the attribute data U_PK_data **53** described for the ID as shown in FIG. **5(b)**. Thus, the description thereof will be omitted herein. The management file generating section **106** generates the management information **13** such that the management information **13** matches the data structure described above.

Next, respective components of the data processor **10**, which perform its playback function, will be described with reference to FIG. **2** again. The data processor **10** includes a video signal output section **110**, a decoding section **111**, an audio signal output section **112**, a reading section **113**, a reading control section **114**, a management information retaining memory **118**, and the pickup **130**.

The reading section **113** gets the data on the optical

disk **131** read by the pickup **130** and acquires it as digital data. This read operation is carried out in accordance with the instruction of the reading control section **114**. Before giving the instruction to read that data, the reading control section **114** instructs the reading section **113** to read the management information file **14** from the management information area **132** of the optical disk **131**. The management information retaining memory **118** retains the management information **13** extracted from the management file **14** that has been read. After having been instructed to read the data, the reading control section **114** finds the storage location in the AV data area **133** in accordance with the access information in the Sample Table Box **18** in the management information retaining memory **118**. The pickup **130** and reading section **113** read a sample **15**, of which the storage location has been found.

The decoding section **111** receives the compressed and encoded video and/or audio data and performs a decoding process thereon according to the compression format, thereby outputting video data and/or audio data. In response, the video signal output section **110** and audio signal output

section **112** output the decoded video signal and/or audio signal, respectively, to a TV and a loudspeaker, for example.

Next, respective components of the data processor **10**, which performs its function of transferring a data stream, will be described. To perform the transfer function, the data processor **10** includes a converting section **121** and an output digital interface section **122**.

The converting section **121** operates in accordance with the decision made by the reading control section **114** about whether or not the format should be converted as will be described later. If it is determined that the format need not be converted, then the converting section **121** outputs the moving picture stream **11** as it is without converting it at all. On the other hand, if it is determined that the format should be converted, then the converting section **121** converts the recording format of the moving picture stream **11** stored in the AV data area **133** on the optical disk **131** into that specified by the reading control section **114**. For example, if the moving picture stream **11** has a VR-compliant data structure and if the management file is stored in the MP4 file format,

then the converting section **121** decodes the moving picture stream **11** once, compresses and encodes the stream again such that the stream has a format complying with the Video standard, and then outputs the resultant stream. Alternatively, the management file may be converted from the MP4 file format into the Video standard in some cases. This means that if the management file has a different file structure, the management file also needs to be converted.

As another alternative, other conversion processes may also be done. Both a VR-compliant moving picture stream and a Video-compliant moving picture stream include a plurality of video objects (VOBs), each of which consists of a plurality of video object units (VOBUs). The VOBU corresponds to the sample **15** (i.e. P2sample) shown in FIG. **4**. Each VOBU includes video packs storing video data and audio packs storing audio data. Thus, the converting section **121** may use the respective packs compliant with the VR standard as packs compliant with the Video standard as they are.

Meanwhile, the converting section **121** converts a real time information pack (RDI pack) arranged at the top of a VOBU

compliant with the VR standard into a navigation pack (navi pack) compliant with the Video standard. Both of these packs contain information for controlling the playback of video data and audio data in a moving picture stream and have data structures defined by their respective standards. Also, the converting section **121** converts the first video pack and the first audio pack of each top VOBU compliant with the VR standard into a video pack and an audio pack having no PES extension fields. However, the video pack and audio pack that appear first in a VOB are not converted but left as they are. In performing the conversion, the PES extension field may be deleted and the data length may be adjusted to a fixed pack length of 2,048 bytes. In the PES extension field, information needed for decoding a program stream (e.g., the capacity of a decoding data buffer) may be described. According to this processing technique, not all video data and audio data need to be decoded or compressed and encoded again. As a result, the processing can be speeded up and the deterioration of quality can be minimized.

Next, the output digital interface section **122** (which

will be abbreviated herein as the "output D-IF section **122**") receives a moving picture stream and then outputs the moving picture stream in compliance with a communication protocol defined by the IEEE 1394 standard, for example. In FIG. **2**, the output D-IF section **122** and the input D-IF section **103** are shown as separate ones. However, these are illustrated as different ones just for the sake of description and may be combined into a single one, too. For example, in an IEEE 1394 interface, data may be input and output through just one connector.

It should be noted that to transfer a data stream, the data stream needs to be read out from the optical disk **131**. To read the data stream, the reading section **113**, reading control section **114**, management information retaining memory **118** and pickup **130** are needed as in the playback operation. These components operate almost as already described for the playback function of the data processor **10**. The differences will be described next with reference to FIG. **7** along with the procedure of the processing done by the data processor **10**.

FIG. **7** shows the procedure of the transfer process to be

done by the data processor **10**. First, before the process is started, the user connects the output digital interface section **122** (to be described later) of the data processor **10** to the input terminal of the DVD recorder **20** with an IEEE 1394 compliant cable, for example, and inputs an instruction to transfer a data stream to the DVD recorder **20** by using a remote controller (not shown) of the data processor **10**, for instance. Then, in Step **S71**, the reading control section **114** of the data processor **10** receives the instruction to transfer a moving picture stream **11**. On receiving this instruction, the reading control section **114** acquires the U_PK attribute information **19** from the management information retaining memory **118** in the next processing step **S72**, thereby identifying the format of the moving picture stream **11**. In this example, the moving picture stream **11** has a VR-compliant format.

Next, in Step **S73**, the output D-IF section **122** inquires the DVD recorder **20** as the drive on the receiving end, and the input D-IF section **103** acquires the information about the format that makes the moving picture stream recordable or

playable by the DVD recorder **20** (which will be referred to herein as "format information"). The format information is sent to the reading control section **114**.

For example, the data processor **10** may acquire the format information from the DVD recorder **20** in compliance the IEEE 1394 communication protocol. Alternatively, the data processor **10** may also detect the format information of the DVD recorder **20** by using a communication protocol defined by the HDMI standard. More specifically, the data processor **10** transmits a control command to the DVD recorder **20** in accordance with the HDMI standard to request device identity information showing the name of manufacturer, the model and so on, and receives the device identity information from the DVD recorder **20** in compliance with the HDMI standard, too. Then, the reading control section **114** makes reference to a table that is stored in an internal memory of the data processor **10** or an external memory card (not shown). In the table, correspondence between the device identity information and the format information of that device is described. In accordance with these pieces of information, the reading control section

114 can collect the information about the format compatible with the DVD recorder **20**. Optionally, the reading control section **114** may acquire, as the format information, the format name that has been input by the user with the remote controller.

Next, in Step **S74**, the reading control section **114** determines whether or not the U_PK attribute information **19** and format information agree with each other. In this preferred embodiment, the U_PK attribute information **19** shows that the stream has the VR-compliant format. Accordingly, if the format information also shows the VR-compliant format, then the reading control section **114** determines that no conversion needs to be done and the process advances to Step **S75**. On the other hand, if the format information shows a format other than the VR-compliant format (e.g., the Video-compliant format), then the reading control section **114** determines that the conversion should be done and the process advances to Step **S76**.

In Step **S75**, the data processor **10** spins the optical disk **131** at a velocity that is several to several tens of times as

high as the read rate during a normal playback operation, thereby getting the moving picture stream **11** read by the pickup **130** and reading section **113** at a rate that is several to several tens of times as high as the read rate during a normal playback operation. Such processing can be carried out because the converting section **121**, to which the moving picture stream **11** has been transmitted, need not convert the stream and there is no need to wait until the converting section **121** finishes its processing. Once the moving picture stream **11** has been read, the converting section **121** sends the moving picture stream **11** as it is to the output D-IF section **122**, which also transfers the moving picture stream **11** as it is to the DVD recorder **20**. When the transfer is done, the processing ends.

In Step **S76** on the other hand, the pickup **130** and reading section **113** read the moving picture stream from the optical disk **131** at a normal rate, and the converting section **121** converts the format in accordance with the format information of the DVD recorder **20** as the drive on the receiving end. Furthermore, in Step **S77**, the converting section **121** changes

the U_PK attribute information (U_PK_ID) **52** and U_PK_data **53** in the auxiliary information pack (U_PK) **40** in accordance with the format of the converted moving picture stream. Thereafter, in Step **S78**, the output D-IF section **122** transfers the converted moving picture stream to the DVD recorder **20**. The DVD recorder **20** can receive the converted moving picture stream and record it on the storage medium **134** as it is. Thus, no conversion processing load is placed on the DVD recorder **20** and its hardware resource can be used effectively for other purposes.

In the preferred embodiments of the present invention described above, the optical disk **131** is supposed to be a DVD-RAM disk. As to optical disks, however, there are various standards. Thus, the DVD-RAM disk may be replaced with an MO, a DVD-R, a DVD-RW, a DVD+RW, a CD-R or a CD-RW. It should be noted that the storage medium may be a removable storage medium other than the optical disk **131** (e.g., a semiconductor memory card) and may also be a hard disk, a semiconductor memory or any other component that forms an integral part of the data processor **10**.

Also, in the preferred embodiment described above, the MP4 file format is supposed to be used such that the U_PK attribute information **19** is stored in one (i.e., U_PK Information Box) of the movie boxes that are BOX structures. However, such a BOX structure is not an essential requirement for the present invention. Alternatively, any other data structure may be adopted as long as the U_PK attribute information is included in management information so as to be easily retrievable from it.

In the foregoing description of the MP4 file format, the moving picture file **12** and management file **14** are supposed to be stored as two separate files on the optical disk **131**. However, this is not an essential requirement for the present invention, either. For example, only the moving picture file **12** may be stored there by itself. In transferring the moving picture stream described above, the reading control section **114** may read the U_PK attribute information **52** directly from the auxiliary information pack **50** of the moving picture stream **11** that is stored as the moving picture file **12** to identify the format of the moving picture stream **11**.

If either the format information of the DVD recorder **20** or the attribute information specifying the format of the data stream is fixed (e.g., if it is known in advance that only a device accepting processing in one particular format can be connected to the data processor **10** or if the format of the data stream is defined in advance and the attribute information is fixed), then the reading control section may determine, by at least one of the attribute information and format information, whether or not the format of the data stream should be converted.

The transfer function of the data processor is realized by executing a computer program that defines the processing procedure shown in FIG. 7. By executing such a computer program, a computer including the data processor operates the respective components of the data processor and performs the processing described above. The computer program may be circulated on the market by being stored on a storage medium such as a CD-ROM or downloaded over telecommunications lines such as the Internet. As a result, even a computer system can also perform a transfer process just like the data processor

described above.

INDUSTRIAL APPLICABILITY

According to the present invention, when a data stream is transferred, it is determined whether or not the data stream has a format that is compatible with the device on the receiving end. If the answer is YES, the data stream is transferred as it is without being processed at all. Otherwise, the data stream is converted into a compatible format and then transferred. When the data stream is transferred without being processed, there is no limit on the read rate of the data stream. Thus, the data stream can be read out from the storage medium and transferred at high speed. And the device in the receiving end may record the received data stream as it is. Consequently, the processing load on the device on the receiving end due to the conversion process, for example, can be reduced.